CENTERS FOR DISEASE CONTROL

Vol. 37 / No. SS-2

MMWR

MORBIDITY AND MORTALITY WEEKLY REPORT

CDC Surveillance Summaries

June 1988

Contents

U.S. Department of Health and Human Services
Public Health Service
Centers for Disease Control
Atlanta, Georgia 30333

This report is published by the Epidemiology Program Office, Centers for Disease Control, Public Health Service, U.S. Department of Health and Human Services, Atlanta, Georgia 30333.

SUGGESTED CITATIONS

General: Centers for Disease Control. *CDC Surveillance Summaries*, June 1988. *MMWR* 1988;37(No. SS-2).

Specific: Centers for Disease Control. [Title of particular article/chapter.] In: *CDC Surveillance Summaries*, June 1988. *MMWR* 1988;37(No. SS-2):[inclusive page numbers].

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Contents

Foreword

The purpose of the *CDC Surveillance Summaries* is to make available the most current information on conditions of public health interest for which CDC has major responsibility. The reports in this publication complement data provided in the *Morbidity and Mortality Weekly Report (MMWR)* and other publications.

History of CDC Surveillance Activities

CDC has been actively involved in disease-surveillance activities since the formulation of the Communicable Disease Center in 1946. The original scope of the National Surveillance Program included the study of malaria, murine typhus, smallpox, psittacosis, diphtheria, leprosy, and sylvatic plague. In 1954, a Surveillance Section was established within the Epidemiology Branch of CDC, primarily concerned with planning and conducting continuing surveillance and making periodic reports. National emergencies such as the Asian influenza pandemic and the discovery of Legionnaires' disease have prompted the involvement of CDC in new surveillance activities. Over the years the surveillance activities of CDC have expanded to include not only new areas in infectious disease but also programs in human reproduction, injuries, environmental health, chronic disease, risk reduction, and occupational safety and health. Ongoing evaluation of these programs has led to new methods of data collection and analysis and has prompted examination of how data are disseminated to the public health community.

The publication titled *CDC Surveillance Summaries* was initiated in 1982 after a survey was made of CDC staff and state epidemiologists. Results of the survey suggested that improved coordination of surveillance reports with the *MMWR* and the *MMWR Annual Summary* (later titled *Summary of Notifiable Diseases, United States*) would facilitate timely publication; provide greater uniformity in the acquisition, evaluation, and reporting of surveillance data; and encourage the use of these data.

In 1985, the CDC Surveillance Coordination Group was formed with representatives from all Centers/Institute/Program Offices and from the Council of State and Territorial Epidemiologists. The Group was charged with developing and implementing a policy for CDC's epidemiologic surveillance activities. Since 1987, representatives from other state and local public health organizations have also actively participated in the activities of the Group. These activities, which are documented in an annual report, are directed toward achieving the following goals: 1) conduct epidemiologic surveillance of all health events considered to be of high priority, 2) evaluate regularly all CDC surveillance activities, 3) develop and evaluate improved methods for the collection, analysis, and dissemination of surveillance data, and 4) maintain and improve the expertise of CDC staff and constituents in the development, implementation, and evaluation of systems of epidemiologic surveillance.

Data Sources

Data on the reported occurrence of notifiable diseases are derived from reports supplied by the state and territorial health departments and by CDC program activities. These data are published weekly in the *MMWR*, and the final official numbers of cases are published in the annual *Summary of Notifiable Diseases*. Complementary data are provided in other *MMWR* auxiliary publications. Data reported in the weekly *MMWR* and the more detailed data reported by individual CDC programs are collected independently; therefore, some numbers may be slightly different because of the timing of reports or because of refinements in case definition.

The data published in *MMWR* and auxiliary publications should be interpreted with caution. Some diseases that cause severe clinical illness and are associated with serious consequences are probably reported quite accurately; however, diseases that are clinically mild and infrequently associated with serious consequences are less likely to be reported. Additionally, subclinical cases are seldom detected except in the course of epidemic investigations or special studies. The degree of completeness of reporting is also influenced by the diagnostic facilities available, the control measures in effect, and the interests and priorities of state and local officials responsible for disease control and surveillance. Finally, factors such as the introduction of new diagnostic tests and the discovery of new disease entities may cause changes in disease reporting independent of the true incidence of disease. Despite these limitations, the data in these reports have proven to be very useful in the analysis of trends.

Inventory of Public Health Surveillance Systems
Centers for Disease Control

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Abortion (legal, induced)	CHPE*	State health departments	1986, *SS* 36/1 (1982-83 data)
Acquired immunodeficiency syndrome (AIDS):			
Cases	CID	State and local health departments, Dept. of Defense, American Red Cross, sentinel hospitals	Weekly, *MMWR*; 1987, *SND* (1986 data); frequent *MMWR* articles
Exposed health care workers	CID	Hospitals, medical centers	1987, *MMWR*
Hemophilia patients	CID	Physicians, hemophilia treatment centers, state health departments	1985 1987, *MMWR*
Human immunodeficiency virus (HIV) infections	CID	Department of Defense (military recruits)	Weekly; frequent *MMWR* articles
	CID	Blood banks (blood donors)	Weekly; frequent *MMWR* articles
	CID, CPS, CHPE	State and local health departments, sentinel hospitals (persons admitted with non-AIDS diagnoses), newborn screening, drug abuse, sexually transmitted diseases	Weekly; frequent *MMWR* articles
Aedes albopictus	CID	State and local health departments, local vector abatement districts, field investigations, PAHO	1986, *MMWR*
Alcohol-related morbidity and mortality	CEHIC	NCHS Health Interview Survey, National Institute on Drug Abuse, Behavioral Risk Factor Survey	1986, *SS* 35/2 (1980-83 data)
Alcohol use (binge drinking, heavy use, drinking and driving)	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	*MMWR* 1987;35:788-91 and 36:66, 71-4
Amebiasis	EPO	State health departments, NNDSS	1987, *SND* (1986 data)
Anthrax	EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Behavioral Risk Factor Surveillance System (prevalence of behaviors associated with adverse health outcomes) (See also listings for individual risk factors.)	CHPE	Self-reported behaviors from telephone surveys, health departments—34 states, DC	Submitted to *Public Health Rep* (1981-86 data); *MMWR* 1986;35:740-3

*All abbreviations are listed at end of inventory. Source of information: the CDC Surveillance Coordination Group.

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Beryllliosis cohorts: registry of disease and exposure	NIOSH		March 1983 (1951-80 data)
Birth Defects, Metropolitan Atlanta Congenital Defects Program	CEHIC	Birth and pediatric referral hospitals, cytogenetic laboratories, vital records	March 1988 (1982-85 data)
Birth Defects Monitoring Program	CEHIC	Commission for Professional and Hospital Activities (hospital discharges); McDonnell Douglas Health Information Systems	March 1988 (1982-85 data)
Botulism	CID, EPO	State health departments, antitoxin network, NNDSS	Weekly, MMWR; 1987, *SND* (1986 data); 1986, *Am J Epidemiol* (1976-84 data)
Breast cancer screening, use of	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	None
Brucellosis	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Campylobacter	CID, EPO	State health departments, NNDSS	June 1988, *SS* 37/2 (1982-86 data)
Cancer, reproductive tract	CHPE	SEER cancer registries, regional cancer registries	1986, *SS* 35/2 (1973-81 data)
Chancroid	CPS	State health departments	1987, *SND* (1986 data)
Cholera	EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Cholesterol screening, use of	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	None
Chronic disease and injury risk factors (prevalence in selected US communities)	CHPE	20 Community demonstration projects	None
Chronic diseases and AIDS knowledge	CHPE	State health departments—34 states, DC, Puerto Rico (See Behavioral Risk Factor Surveillance System.)	None
Coal workers' pneumoconiosis	NIOSH	Periodic sample, cross-sectional surveys of a sample of miners, death certificates, Social Security disability awards, NCHS Health Interview Survey	None
Congenital malformations (See Birth Defects and Birth Defects Monitoring Program)			

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Contraception, reversible	CHPE	Idaho and Georgia surveys; state-based telephone surveys	1985, *South Med J* (Georgia data)
Dengue	CID	State and local health departments, various Caribbean and South and Central American countries, physicians in Puerto Rico and Virgin Islands, PAHO	1987, *MMWR*
Developmental disabilities	CEHIC	Schools, agencies serving developmentally disabled, metropolitan Atlanta	None
Dialysis-associated diseases	CID	Dialysis centers	1986 (1985 data)
Diphtheria	CPS, EPO	State health departments, antitoxin network, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1985, *Am J Public Health*
Disability in the workplace	NIOSH	Social Security disability awards, NCHS workers' compensation surveys	
Drownings	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1978-84 data)
Drug Abuse Surveillance Project, Atlanta, GA	CEHIC	Atlanta emergency rooms, medical examiners, drug treatment programs, law enforcement agencies	Dec 1987
Ectopic pregnancy	CHPE	NCHS, National Hospital Discharge Survey	1986, *SS* 35/2 (1970-83 data)
Ectopic pregnancy mortality	CHPE	NCHS, National Hospital Discharge Survey	1987, *SS* 36/2 (1979-82 data)
Encephalitis, arboviral	CID	State and local health departments, Veterans Administration Hospitals, private laboratories, state agriculture departments, local mosquito control districts	Weekly, *MMWR*; 1987, *MMWR* (1986 data)
Encephalitis, primary and postinfectious	EPO	State health departments, NNDDS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Exercise (sedentary lifestyle and activity patterns)	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	*MMWR* 1987;36: 195-205
Fall-related fatalities	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1978-84 data)
Fire (residential)-related fatalities	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1978-84 data)
Firearm-related fatalities (excluding intentional)	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1970-84 data)
Foodborne diseases	CID	State health departments	1986, *SS* 35/1 (1982 data)

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Gonorrhea	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Granuloma inguinale	CPS	State health departments	1987, *SND* (1986 data)
Hepatitis A; B; non-A, non-B; unspecified	CID, EPO	State health departments, NNDSS, sentinel health departments	Weekly, *MMWR*; 1987, *SND* (1986 data); 1987 (1985 data)
Herpes genitalis	CPS	National Drug and Therapeutic Index	None
Home injury-related fatalities among children	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1970-84 data)
Homicide	CEHIC	NCHS, National mortality, data, Federal Bureau of Investigation Uniform Crime Reporting System	Feb 1988, *SS* 37/1 (1970-84 data)
Human papilloma virus	CPS	National Drug and Therapeutic Index	None
Hypertension treatment	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	*MMWR* 1987;36:260-7
Immunization-related adverse events	CPS	State health departments	1985, *MMWR*
Influenza	CID	Sentinel physicians, state health departments, laboratories, NCHS, national vital records. (See also influenza, pneumonia, and total mortality.)	1986, *MMWR* (1985-86 data)
Influenza, pneumonia, and total mortality	EPO	Vital statistics registrars of 121 cities	Weekly, *MMWR*
Injuries among American Indians	CEHIC	Indian Health Service (3 service units), hospital discharges, medical examiners, fire/emergency medical services, police records, personal interviews	None
Injuries among the elderly	CEHIC	1 county, hospital discharges, emergency rooms, medical examiner, fire rescue service	None
Injuries in a low socioeconomic status community	CEHIC	Hospital discharges, emergency rooms, medical examiners, vital records, emergency medical services	None
Kawasaki syndrome	CID	State health departments, physicians	1984
Lead poisoning among workers (occupational disability)	NIOSH	Selected states, workers' compensation data, laboratories, sentinel physicians	1983 (1976-80 data)

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Legionellosis	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1985, *J Infect Dis* (1970-82 data)
Leprosy	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1985, *J Infect Dis* (1971-81 data)
Leptospirosis	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1979 (1978 data)
Lyme disease	CID	State health departments	June 1985, *MMWR* (1984 data)
Lymphogranuloma venereum	CPS	State health departments	Sept 1987, *SND* (1986 data)
Malaria	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1986 (1985 data)
Measles	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1986, *MMWR* 1982 (1977-81 data)
Meningitis, aseptic	EPO	State health departments, NNDSS	Weekly, *MMWR* 1987, *SND* (1986 data)
Meningitis, bacterial	CID	State health departments	1985, *JAMA* (1978-81 data)
Meningococcal infections	EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Mortality, fetal/infant	CHPE	National Infant Mortality Surveillance, state health departments—50 states, DC, Puerto Rico	April 1987, *Public Health Rep*
Motor vehicle-related fatalities	CEHIC	NCHS, national mortality data, Fatal Accident Reporting System	Feb 1988, *SS* 37/1 (1978-84 data)
Motor vehicle-related fatalities among children under 15 years of age	CEHIC	NCHS, national mortality data, Fatal Accident Reporting System	Feb 1988, *SS* 37/1 (1978-84 data)
Mumps	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1978 (1974-76 data)
Neonatal Screening Standardization Program	CEHIC	State public health laboratories	None
Nosocomial infections	CID	66 acute-care hospitals	1985, *SS* 34/3 (1984 data)

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Notifiable diseases (See also listings for individual diseases.)	EPO	State health departments	Weekly, *MMWR*; 1987, *SND* (1986 data)
Nutrition, pediatric	CHPE	Public clinics, Head Start, 34 states and DC	1986, *MMWR*
Nutrition, pregnancy	CHPE	Public clinics, 18 states	1986, Annual State Reports
Occupational hazards	NIOSH	National Occupational Hazard Survey, 1972-74; National Occupational Exposure Survey, 1981-83	1985, *SS* 34/2 (1970-82 data)
Occupational hazards, mining	NIOSH	National Occupational Health Survey of Mining	1986, *SS* 35/2
Occupational morbidity	NIOSH	NCHS Surveys, National Hospital Discharge Survey, Social Security disability awards, workers' compensation data, laboratory-based occupational disease reports	Frequent *MMWR* articles
Occupational mortality related to electrical contact, confined spaces, excavation, Fatal Accident Circumstances and Epidemiology	NIOSH	States	
Occupational mortality	NIOSH	State vital records, death certificates from states for selected work-related injuries/deaths	*MMWR* articles, as appropriate
Overweight	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	1986, *Am J Clin Nutr* 1986; 44:410-6
Pelvic inflammatory disease	CPS	State health departments, National Drug and Therapeutic Index	1983, *SS* 32/4 (1965-82 data)
Pertussis	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Plague	CID, EPO	State and local health departments, NNDSS; US Departments of Agriculture, Interior, and Defense; Indian Health Service; field investigations	Weekly, *MMWR*; 1987, *SND* (1986 data); 1985, *SS* 34/2 (1984 data)
Pneumococcal disease	CID	Laboratories	1986, *Ann Intern Med* (1978-84 data)
Poliomyelitis, paralytic	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1986, *MMWR* 1982 (1980-81 data)
Pregnancy mortality	CHPE	State health departments (7), NCHS	1986, *MMWR* (1983 data)

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Pregnancy outcomes	CHPE	NCHS	None
Premature births, low birthweight	CHPE	State health departments—50 states, DC, Puerto Rico	April 1987, *Public Health Rep*
Premature mortality (years of potential life lost), by leading causes	EPO	NCHS, national vital records	1988, *MMWR* (1986 data)
Pseudomonas cepacia infections, cystic fibrosis patients	CID	Cystic fibrosis centers	None
Psittacosis	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); June 1987 (1975-84 data)
Rabies, animal/human	CID, EPO	State health departments, physicians, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); Aug 1987 (1986 data)
Respiratory and enterovirus surveillance	CID	State health departments	1986, *J Infect Dis* (1984-85 data); 1986, *MMWR*
Reye syndrome	CID	State health departments	1986, *Pediatrics* (1985 data)
Rheumatic fever	EPO	State health departments, NNDSS	1987, *SND* (1977-86 data)
Rocky Mountain spotted fever (tick-borne typhus fever)	CID	State health departments, physicians	1986, *MMWR* (1985 data)
Rubella	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1984, *SS* 33/4 (1983 data)
Rubella, congenital	CPS, EPO	State health departments, NNDSS	1986, *MMWR*; 1984, *SS* 33/4 (1983 data)
Rubella, vaccination during pregnancy	CPS	State health departments	1986, *MMWR*
Salmonellosis	CID, EPO	State health departments, NNDSS	June 1988, *SS* 37/2 (1984-86 data)
Scalds, tap water (hospitalizations)	CEHIC	NCHS, National Electronic Injury Surveillance System	Feb 1988, *SS* 37/1 (1978-85 data)
Seatbelts, use of	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	*MMWR* 1987;36:252-4
Shigellosis	CID, EPO	State health departments, NNDSS	1987, *SND* (1986 data)
Smokeless tobacco, use of	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	1987, *MMWR* 1987;36:337-40

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Smoking, current	CHPE	State health departments—34 states, DC (See Behavioral Risk Factor Surveillance System.)	*MMWR* 1987; 36:252-4
Sterilization, female surgical	CHPE	NCHS, National Hospital Discharge Survey	Hysterectomy: *1986, MMWR* 1970-82 data) Tubal: 1983, *SS* 32/3 (1970-80 data)
Sudden unexplained death syndrome	CEHIC	State health departments, medical examiners, coroners	1987, *SS* 36/1 (1975-86 data)
Suicide	CEHIC	NCHS, national mortality data	Feb 1988, *SS* 37/1 (1970-84 data)
Syphilis	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Syphilis, congenital	CPS	State health departments	Weekly, *MMWR*
Teen pregnancy/fertility	CHPE	NCHS, National Natality Survey, National Survey of Family Growth, state health departments	1987, *JAMA* (1974-83 data)
Tetanus	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Tobacco, adult use of	CHPE	US sample	1987, EIS Conference Program
Tobacco, health consequences/costs	CHPE	State health departments—40	Dec 1986, Surgeon General's Report on Health Consequences of Involuntary Smoking
Toxic shock syndrome	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1984, *SS* 33/3 (1960-84 data)
Trichinosis	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1987, *SS* 36/2 (1965 data)
Tuberculosis	CPS, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Tularemia	EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data)
Typhoid fever	CID, EPO	State health departments, NNDSS	Weekly, *MMWR*; 1987, *SND* (1986 data); 1988, in press (1975-84 data)

Surveillance System	Responsible Organizational Unit	Data Source(s)	Most Recent Report/Summary
Typhus fever, endemic/murine	EPO	State health departments, NNDSS	1987, *SND* (1986 data)
Typhus fever, tick-borne (See Rocky Mountain spotted fever.)			
Varicella	EPO	State health departments, NNDSS	1987, *SND* (1986 data)
Water-related diseases	CID	State health departments	June 1988, *SS* 37/2 (1985 data)

Abbreviations

AIDS	Acquired immunodeficiency syndrome
Am J Clin Nutr	*American Journal of Clinical Nutrition*
Am J Epidemiol	*American Journal of Epidemiology*
Am J Public Health	*American Journal of Public Health*
Ann Intern Med	*Annals of Internal Medicine*
CEHIC	Center for Environomental Health and Injury Control
CHPE	Center for Health Promotion and Education
CID	Center for Infectious Diseases
CPS	Center for Prevention Services
DC	District of Columbia
EIS	Epidemic Intelligence Service
EPO	Epidemiology Program Office
JAMA	*Journal of the American Medical Association*
J Infect Dis	*Journal of Infectious Diseases*
MMWR	*Morbidity and Mortality Weekly Report*
NCHS	National Center for Health Statistics
NIOSH	National Institute for Occupational Safety and Health
NNDSS	National Notifiable Diseases Surveillance System
PAHO	Pan American Health Organization
SEER	Surveillance, Epidemiology, and End Results
SND	*Summary of Notifiable Diseases* (auxiliary publication of *MMWR*)
SS	*Surveillance Summaries* (auxiliary publication of *MMWR*)
US	United States

Campylobacter Isolates in the United States, 1982-1986*

Robert V. Tauxe, M.D., M.P.H.
Nancy Hargrett-Bean, Ph.D.
Charlotte M. Patton, M.S.
I. Kaye Wachsmuth, Ph.D.
Enteric Diseases Branch and Statistical Services Activity
Division of Bacterial Diseases
Center for Infectious Diseases

INTRODUCTION

Campylobacter organisms have long been recognized as a cause of diarrhea in cattle and of septic abortion in both cattle and sheep, but they have only recently been recognized as an important cause of human illness. Both *Campylobacter fetus* subspecies *fetus* (referred to then as *Vibrio fetus*) and *Campylobacter jejuni* (related *Vibrio*) were isolated from blood cultures of humans in the 1950s and were thought to be rare and perhaps opportunistic pathogens (*1*). *C. jejuni* was first isolated from the diarrheal stools of humans in 1972, with use of a filtration technique developed in veterinary medicine (*2,3*). The development of selective *Campylobacter* stool culture media by Skirrow and by Blaser led to the recognition that *Campylobacter* was a common cause of human diarrheal illness in many countries (*4,5*). In a study conducted at eight U.S. hospitals in 1980 and 1981, 4.4% of patients with diarrheal illness had *Campylobacter* isolated from stools; by comparison, 2.3% had *Salmonella* and 0.9% had *Shigella* isolated (*6*).

The taxonomy of *Campylobacter* has been expanding rapidly. Currently, there are nine named or proposed species that may be pathogenic in humans (Table 1). All of

*The authors would like to recognize the crucial contributions of the two Belgian researchers, P.J. Dekeyser, D.V.M., and J.-P. Butzler, M.D., who brought human campylobacteriosis to the attention of the world.

TABLE 1. *Campylobacter* species that are pathogenic or potentially pathogenic in humans

Current name	Previous names
C. jejuni	*C. fetus* subsp *jejuni*, related *Vibrio*
C. coli	
C. laridis	Nalidixic acid-resistant thermophilic *Campylobacter*
C. fetus subsp *fetus*	*C. fetus* subsp *intestinalis*, *Vibrio fetus*
C. hyointestinalis	
*"C. cinaedi"**	*Campylobacter*-like organism-1A†
*"C. fennelliae"**	*Campylobacter*-like organism-2
*"C. upsaliensis"**	Catalase-negative or weak strains
C. pylori	*C. pyloridis*, gastric *Campylobacter*-like organism

*Proposed species name.
†A separate and unnamed species, *Campylobacter*-like organism-1B, can be distinguished from *Campylobacter*-like organism-1A by DNA hybridization studies, but is biochemically indistinguishable from *"C. cinaedi."*

them are curved gram-negative motile rods that are microaerophilic and oxidase-positive. The organisms do not ferment carbohydrates but can usually be distinguished from one another by a variety of biochemical tests and growth characteristics (Table 2). One species, *Campylobacter pylori*, differs from other *Campylobacter* species in several important ways and may prove to belong to a separate genus (*7*).

Laboratory-based national surveillance of *Campylobacter* infections in the United States began in 1982 with a panel of 11 states (*8*). Thirty-one states joined in surveillance in 1983, and since then the panel has been relatively constant. Published reports have summarized the results of surveillance for 1983-1984 and the epidemiology of common-source outbreaks of *Campylobacter* infections (*9-11*). The surveillance goals were 1) to describe the epidemiology of infections with these organisms, 2) to detect and investigate outbreaks, and 3) to generate hypotheses for further research (*12*). This report reviews the first 5 years of CDC's *Campylobacter* surveillance in the United States.

METHODS

The national *Campylobacter* surveillance system is a passive laboratory-based surveillance system, similar to the national *Salmonella* and *Shigella* surveillance systems. Weekly reports of laboratory isolates of *Campylobacter* are mailed from participating state health departments to the Enteric Diseases Branch, Division of Bacterial Diseases, Center for Infectious Diseases, CDC. The data reported include species of *Campylobacter*; name, age, sex, and county of residence of the person from whom *Campylobacter* was isolated; and the clinical source of the isolate. No

TABLE 2. Selected phenotypic characteristics of *Campylobacter* species that are pathogenic or potentially pathogenic in humans*

Species	Growth at 25°C	Growth at 42°C	Growth in 1% glycine	H_2S in triple sugar iron	Catalase	Nitrate reduction	Hippurate hydrolysis	Urea hydrolysis	Resistance to Nalidixic acid	Resistance to Cephalothin
C. jejuni	–	+	+	–	+	+	+†	–	S§	R
C. coli	–	+	+	d	+	+	–	–	S	R
C. laridis	–	+	+	–	+	+	–	–	R	R
C. fetus subsp *fetus*	+	d	+¶	–	+	+	–	–	R	S**
C. hyointestinalis	d	+	+	+††	+	+	–	–	R	S
"*C. cinsedi*"§§	–	d	+	–	+	+	–	–	S	S
"*C. fennelliae*"§§	–	d	+	–	+	–	–	–	S	S
"*C. upsaliensis*"§§	–	+	d	–	–	+	–	–	S	S
C. pylori	–	–	+	–	+	–	–	+	R	S

*Symbols: (+), 90% or more of strains are positive; (-), 90% or more of strains are negative; (d), 11-89% of strains are positive; (R), resistant; (S), susceptible. See reference 45 for test procedures.
†Hippurate-negative *C. jejuni* have been reported.
§Nalidixic-acid resistant *C. jejuni* have been reported.
¶*C. fetus* subsp *venerealis* does not grow in glycine.
**Cephalothin-resistant *C. fetus* subsp *fetus* strains have been reported.
††Small amount of H_2S on fresh (≤3 days) triple sugar iron slants.
§§Proposed species name.

other clinical information is included, and deaths are not reported. Participating states vary considerably in their internal reporting requirements for *Campylobacter*, which is reflected in the number of *Campylobacter* isolations reported (*8*). Because the data files remain open and late reports may be added, the data included in this report may differ slightly from previously published data.

The population for nonparticipating states, as determined by the 1980 census, was subtracted from the national population for 1980 to determine the national isolation rate for each year of surveillance. Age- and sex-specific isolation rates were calculated for the 5-year span using a denominator of the total number of person-years of observation based on the age and sex distribution of the 1980 census. Incidence rates by month of age in infancy were calculated with a denominator of one-twelfth of the total number of person-years of observation for infants less than 1 year of age.

RESULTS

In the 5 years of surveillance, 41,343 isolates of *Campylobacter* were reported to CDC, resulting in an isolation rate of 5.5 per 100,000 person-years. The annual isolation rate was highest in the first year of surveillance, decreased in the second year when a large number of states began participating, and since then has increased slightly over time (Table 3). A species was reported for 91% of isolates; *C. jejuni* represents 99% of the reported species (Table 4). Other reported species include *C. fetus* subsp *fetus*, *Campylobacter coli*, *Campylobacter laridis*, "*Campylobacter*-like organism," *Campylobacter sputorum*, and "*Campylobacter faecalis*." The last two

TABLE 3. Reported isolates and isolation rates, national *Campylobacter* surveillance system, United States, 1982-1986

Year	No. of states participating	No. of isolates	Isolation rate per 100,000
1982	11	4,031	7.19
1983	42	8,674	4.91
1984	42	8,864	5.02
1985	40	9,753	5.69
1986	39	10,021	5.99

TABLE 4. Isolates of *Campylobacter*, by reported species, United States, 1982-1986

Species	Number
C. jejuni	37,478
C. fetus subsp *fetus*	147
C. coli	78
C. laridis	7
*C. sputorum**	1
"*C. faecalis*"*	1
"*Campylobacter*-like organism"	1
Not reported	3,630
Total	**41,343**

*Species thought to be nonpathogenic.

species are not thought to be pathogenic for humans. Reported isolations of *C. jejuni* have shown a consistent seasonal distribution over the 5-year period (Figure 1). The seasonal distribution patterns of *C. fetus* subsp *fetus* and *C. coli* also show peaks in warm months, although they are less marked than those of *C. jejuni*.

The pattern of age- and sex-specific isolation rates of *Campylobacter* is unique among enteric bacteria (Figure 2). The highest isolation rate occurs in the first year of

FIGURE 1. Reported *Campylobacter* isolates, by month and year, United States, 1982-1986

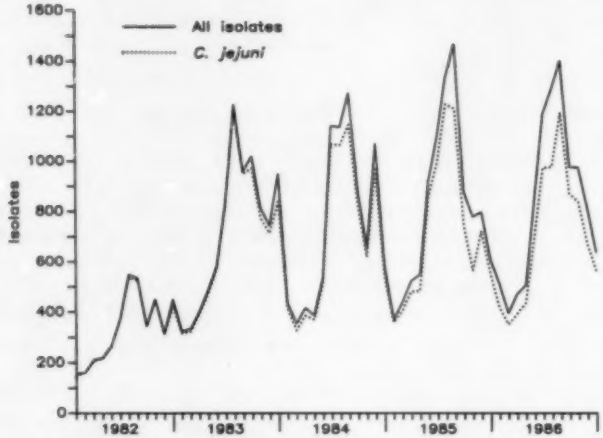
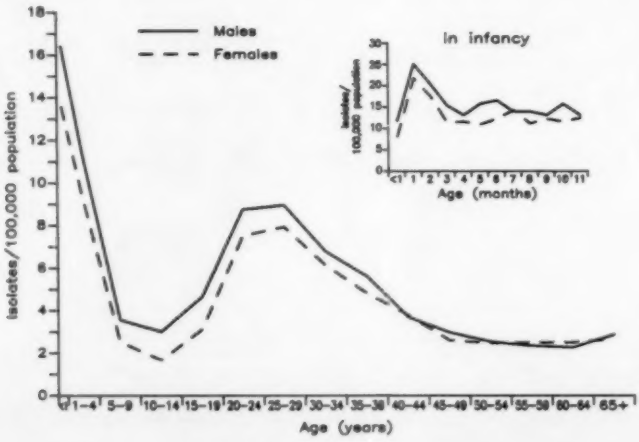


FIGURE 2. Annual isolation rates of *Campylobacter*, by age and sex, United States, 1982-1986



life, reaching 15 per 100,000, but a large second peak occurs in the young adult years. The isolation rate for males is higher than that for females up to age 45; over this age the isolation rates are equal. In the first year of life, the isolation rate is lowest during the first month, is highest in the second month, and levels off after that. *Campylobacter* is isolated more often from male than from female infants; the male-to-female ratio is 1.31:1 for isolates from infants, compared with a ratio of 1.15:1 for isolates from all ages combined.

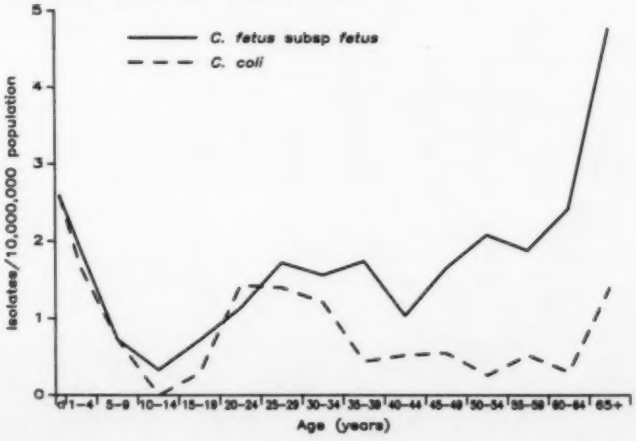
Although overall isolation rates are two orders of magnitude less than for *C. jejuni*, the age-specific isolation rates of *C. coli* and *C. fetus* subsp *fetus* also peak in infancy and increase in young adulthood (Figure 3). *C. coli* appears to have a lower isolation rate among older adults, while that of *C. fetus* subsp *fetus* increases substantially among the elderly.

A clinical source was reported for 76% of the isolates (Table 5). Both *C. jejuni* and *C. coli* came predominantly from stool, whereas 54% of *C. fetus* subsp *fetus* isolates with known source were from blood. Despite this difference, the number of reported *C. jejuni* isolates from blood actually exceeded that of *C. fetus* subsp *fetus* because many more *C. jejuni* infections were reported. The proportion of isolates that came from blood did not vary by sex but did vary by age, and persons with blood isolates tended to be older (median age, 30 years) than persons with stool isolates (median age, 25 years). For *C. fetus* subsp *fetus* the median age for persons with blood isolates was 64 years; that of persons with stool isolates was 32 years. For both species the elderly were at highest relative risk for bacteremia, although this increased risk occurred in persons at a younger age for *C. fetus* subsp *fetus* than for *C. jejuni* (Figure 4).

Common-source outbreaks

CDC receives reports of foodborne and waterborne disease outbreaks, including those caused by *Campylobacter*, as part of the national foodborne and waterborne

FIGURE 3. Annual isolation rates of *Camplyobacter coli* and *Campylobacter fetus* subsp *fetus*, by age, United States, 1982-1986



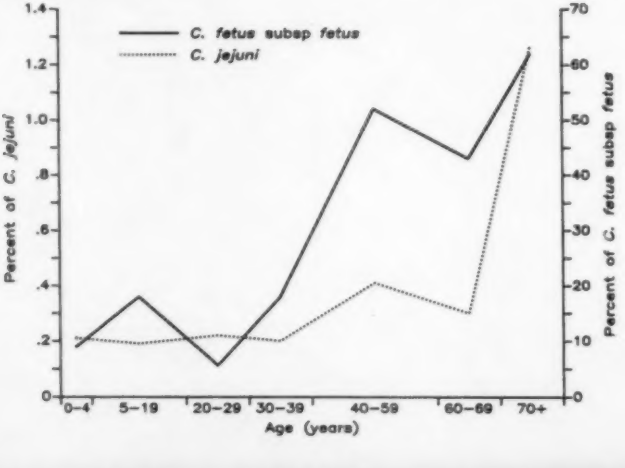
disease surveillance systems. The first reported *Campylobacter* outbreak, in 1978, was also the largest, when a contaminated community water supply affected an estimated 3,000 persons (*13*). Between 1978 and 1986, 57 outbreaks of *Campylobacter* infections were reported, including 11 waterborne outbreaks, 45 foodborne outbreaks, and one outbreak in a tourist group for which the source was unclear (Table 6). A species was reported for 43 outbreaks: 42 outbreaks were due to *C. jejuni*,

TABLE 5. Reported isolates of *Campylobacter*, by species and source of isolate, United States, 1982-1986

Species	Source						
	Stool	Blood*	Gall bladder	Wound or abscess	Other†	Not reported	Total
C. jejuni	29,357	102	5	2	2	8,010	37,478
C. fetus subsp *fetus*	43	57	-	2	4	41	147
C. coli	66	2	-	-	-	10	78
C. laridis	5	1	-	-	-	1	7
C. sputorum	-	1	-	-	-	-	1
"C. faecalis"§	1	-	-	-	-	-	1
Campylobacter-like organism	1	-	-	-	-	-	1
Not Reported	1,926	9	-	-	-	1,695	3,630
Total	**31,399**	**172**	**5**	**4**	**6**	**9,757**	**41,343**

*Includes four *C. jejuni* and two unreported species from both stool and blood, and one *C. fetus* subsp *fetus* isolated from both abscess and blood.
†Includes *C. jejuni* isolates from sputum and vagina, and *C. fetus* subsp *fetus* isolates from pericardial fluid, peritoneal fluid, ankle joint fluid, and "femoral wall."
§Proposed species name.

FIGURE 4. Proportion of *Campylobacter* isolated from blood, by age and species, United States, 1982-1986



including one raw-milk-associated outbreak due to both *C. jejuni* and a thermotolerant strain of *C. fetus* subsp *fetus* (*14*), and one outbreak was due to a cluster of *C. fetus* subsp *fetus* infections in cancer patients (*15*). The median number of cases was 22 in waterborne outbreaks and 14 in foodborne outbreaks. Two fatalities were reported, one occurring during a foodborne outbreak of *C. jejuni* infections at a nursing home, and one occurring in a patient with metastatic melanoma. The latter patient was part of the cluster of *C. fetus* subsp *fetus* infections (*15*). The outbreak-associated case-fatality ratio for *Campylobacter* infections was two per 6,441 or three per 10,000. A vehicle was determined for 80% of the foodborne outbreaks; of these, 70% were caused by raw milk, and 8% were associated with poultry. The waterborne outbreaks were all related to drinking untreated surface water or water supplies with inadequate chlorination.

The seasonality of outbreaks of *Campylobacter* infections differs markedly from that of *Campylobacter* isolates reported through the national surveillance system (Figure 5). The distribution of foodborne and waterborne outbreaks is bimodal, with peaks in May and October. In contrast, outbreaks are rare in the summer months when the reported isolations of *Campylobacter* reach their peak.

The common-source outbreaks reported here were detected or reflected by local *Campylobacter* surveillance efforts. The national *Campylobacter* surveillance system has not been an instrument for the primary detection of local common-source outbreaks. National surveillance data did, however, document a striking event in November 1984, when a large temporary increase occurred in reported *Campylobacter* isolates (*10*). This increase occurred equally in all age groups and in all regions of the country, and the age and sex distributions of cases reported that month were similar to those of cases reported throughout the year. This increase in 1984 appears to have been a nationwide outbreak: no local common-source outbreaks were reported at that time, and the source of the outbreak remains unknown.

DISCUSSION

The interpretation of *Campylobacter* surveillance data has two major limitations: 1) the collected information itself is limited and 2) the reporting systems vary from

TABLE 6. Reported outbreaks of *Campylobacter* infections, by vehicle of transmission, United States, 1978-1986

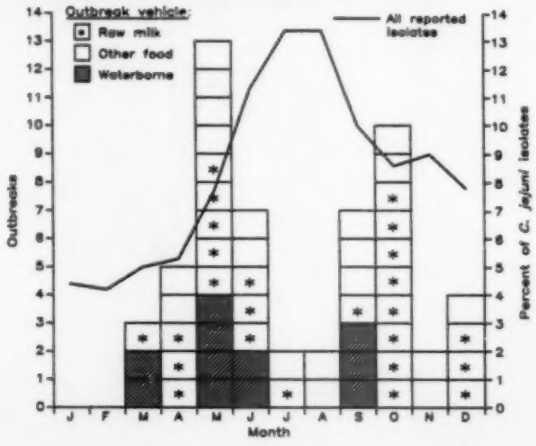
Species	No. of outbreaks	No. of ill persons
All foodborne	45	1,308
Raw milk	26	829
Poultry	3	27
Egg	1	26
Other	6	87
Unknown	9	339
All waterborne	11	4,983
Community water supply	7	4,930
Other	4	53
Travel-associated	1	150
Total	**57**	**6,441**

state to state. Variations in reported isolation rates among states or regions may well reflect differences in surveillance and reporting methods and should not be interpreted as true variation in the incidence of infection. Similarly, surveillance mechanisms within a given state may differ for *Salmonella*, *Shigella*, and *Campylobacter*, so that the isolation rates of these organisms may not be directly comparable.

Nevertheless, the *Campylobacter* isolation rate does not appear to be increasing rapidly. The modest increase in isolation rates between 1983 and 1986 may reflect an increase in the number of laboratories using selective culture media for *Campylobacter*, rather than a real increase in the frequency of infection. The reported number of isolates represents only a small fraction of the true number of isolates and a far smaller fraction of the number of infections that occurred. The population-based isolation rate of *Campylobacter* among members of a Seattle health maintenance organization was 71 per 100,000 per year, and in the city of Dubuque, Iowa, the rate was 28 per 100,000 per year (*16, 17*). These rates may be closer to the actual isolation rate for the country than the national isolation rate reported here.

The 1984 *Campylobacter* isolation rate of five per 100,000 is less than the analogous rate for *Salmonella* (16 per 100,000) and is similar to that of *Shigella* (5.6 per 100,000). However, several studies indicate that, when parallel cultures for all three organisms are done, *Campylobacter* isolations are probably more frequent than *Shigella* and *Salmonella* isolations combined. Among patients seen at hospitals, *Campylobacter* was isolated more frequently than *Salmonella* and *Shigella* by a ratio of 2:1 and 5:1, respectively (*6*). Among citizens of Dubuque the same ratios were 2.5:1 and 14:1; among college students they were 10:1 and 46:1 (*17,18*). Among members of the Seattle health maintenance organization, *Campylobacter* was isolated more frequently than *Salmonella* by a ratio of 2.5:1 (*16*). In national surveillance data the lower reporting of *Campylobacter* compared with other enteric bacterial isolates probably reflects infrequent use of selective media for *Campylobacter* along with

FIGURE 5. Seasonal distribution of reported *Campylobacter* isolates (1982-1986) and outbreaks (1978-1986), by month and vehicle, United States



standard enteric media, fewer referrals of isolates of *Campylobacter* to reference laboratories, and less-stringent reporting requirements for *Campylobacter* than for *Salmonella* or *Shigella*.

The seasonality of *Campylobacter* outbreaks and of reported *Campylobacter* isolates differs profoundly, suggesting that the sources of cases in outbreaks are quite different from the sources of the far more numerous sporadic cases. The reason for the bimodal seasonal distribution of outbreaks is not clear, but it may be related to the observation that the yield of cultures for *Campylobacter* from surface water may be temperature dependent. Reisinger reported that *C. jejuni* could be isolated from surface water in the spring and fall, but it could not be isolated in the summer, when water temperatures were above 25°C (*19*).

The sources of sporadic cases of *Campylobacter* have been defined in several recent case-control investigations. Poultry is the predominant source; contact with pets and consumption of raw milk or surface water also play important roles. In sporadic cases occurring among members of a health maintenance organization in Seattle, at least 50% were accounted for by poultry, and 9% by foreign travel; the single outbreak in the study population was traced to raw goat's milk (*16,20*). Among university students in Georgia, 70% of cases were accounted for by eating chicken, often undercooked or raw, and 30% by contact with cats (*21*). In Dubuque, Iowa, an agricultural area, drinking raw milk was the leading identified risk factor, and 33% of the patients had consumed raw milk (*17*). In Colorado, the identified risk factors were drinking untreated water or raw milk, contact with cats, and eating undercooked chicken, although their independence was not assessed (*22*). In a second study conducted in Colorado, handling raw chicken, as opposed to eating it, emerged as a risk factor (*23*). Poor kitchen hygiene may well play a role; in one study, the risk of infection was inversely associated with the frequency of using soap to clean the kitchen cutting board (*16*).

The predominance of poultry as a source of sporadic infections could explain both the age spectrum and the seasonality of the infection. The predilection of this infection for young adults may be related to their cooking habits as they leave their childhood homes and begin cooking for themselves, the "second weaning" hypothesis. The prevalence of *Campylobacter* contamination of raw poultry products can be as high as 89% and appears to be seasonal with a summer peak (*24,25*).

The explanation for the nationwide November 1984 anomaly remains unknown. However, it appears to have been a nationwide common-source outbreak with the same age and sex distribution as is generally seen for sporadic cases. Poultry is a potential vehicle for such an outbreak.

Person-to-person transmission appears to be uncommon with *C. jejuni*. This rarity is somewhat surprising because volunteer trials indicate that the infectious dose of *C. jejuni* is 500 organisms or fewer, low enough to make person-to-person transmission seem likely (*26,27*). Nonetheless, neither outbreaks nor large numbers of sporadic cases have been reported in situations where person-to-person transmission of other enteric diseases are common, such as day-care centers or mental institutions. Two laboratory-acquired cases were related to handling laboratory reference strains, not to handling clinical specimens (*28,29*). In three published investigations of clusters of *C. jejuni* infections among neonates, no clear evidence of infant-to-infant transmission was reported; one appeared to be due to maternal-infant transmission at birth, and one to an unidentified common source. The route of transmission in one was not

clarified (*30-32*). In a survey of enteric pathogens among homosexual men with intestinal symptoms, *C. jejuni* was found in 6.3% (*33*). In another survey, however, 10.5% of stool cultures from persons aged 20-29 years with diarrheal illness yielded *Campylobacter* (*6*). The lower rate of 6.3%, therefore, does not suggest that homosexual transmission of *C. jejuni* was occurring. Thus, despite the low infectious dose, there is little evidence that *C. jejuni* transmission in the United States is sustained by person-to-person transmission. This may not be the case for all species: "*Campylobacter cinaedi*" and "*Campylobacter fennelliae*," reported almost exclusively from homosexual men, may perhaps be transmitted through homosexual contact (*34*).

Some limited clinical inferences can be drawn from the data. The relative rarity of *C. jejuni* isolates from outside the intestine suggests that this organism is rarely invasive, unlike *C. fetus* subsp *fetus*. Risk factors for bacteremia remain to be determined, although a review of cases of *C. fetus* subsp *fetus* infections reported to CDC indicates that underlying gastrointestinal, hepatic, or immunosuppressive disease may predispose to bacteremia with this organism (*35*). The clinical significance of the *C. jejuni* isolates reported from the biliary tree is unknown, but raises the possibility of biliary carriage of the organism, as has been demonstrated in sheep and cattle (*36*). The single *C. sputorum* isolate came in 1984 from a blood culture of a 77-year-old man with pneumonia. The blood culture from this man also yielded *Peptococcus prevotii*, another oral anaerobe, which indicates that he probably had aspiration pneumonia and leaves the pathogenic role of the *C. sputorum* isolate in doubt. No isolates have yet been reported from cerebrospinal fluid in the United States, although Goossens recently reported an outbreak of *C. jejuni* meningitis in France (*32*).

Currently, there are several technical shortcomings in laboratory-based *Campylobacter* surveillance. Although serotyping systems have been developed for *Campylobacter*, including the heat-stable antigen systems of Penner and of Lauwers and the heat-labile antigen system of Lior, they are labor intensive and have not been adapted for widespread use by reference laboratories (*37-39*). Because serotyping is rarely done, laboratories have little reason to forward routine isolates to reference laboratories; this fact may lead to underreporting.

The predominance of *C. jejuni* among reported isolates from stool cultures may partially be an artifact, as the stool culture media currently in use may not be optimal for other *Campylobacter* species. Media that contain cephalothin will inhibit the growth of most strains of *C. fetus* subsp *fetus*, some strains of *C. coli*, *Campylobacter hyointestinalis*, "*Campylobacter upsaliensis*," and probably most strains of "*C. cinaedi*" and "*C. fennelliae*" (*40-43*). Unless the hippurate hydrolysis test is done, *C. coli* may be misidentified and reported as *C. jejuni*. Hippurate-negative *C. jejuni* occurs but probably infrequently; however, no practical tests are available to separate hippurate-negative *C. jejuni* from *C. coli* (*44*). Similarly, unless resistance to nalidixic acid and hippurate hydrolysis are routinely determined, *C. laridis* may be also misidentified and reported as *C. jejuni*. The frequency with which these tests are applied routinely is unknown. Some potential pathogens such as *C. hyointestinalis*, "*C. upsaliensis*," and two so-called *Campylobacter*-like organisms, "*C. cinaedi*" and "*C. fennelliae*," have not been reported through the surveillance system, although isolates have been forwarded to the national *Campylobacter* reference laboratory for confirmation.

Several questions about the epidemiology of *Campylobacter* are worthy of further research. The sources of the non-*jejuni Campylobacter* species remain to be determined. The sources of *C. jejuni* infections among infants have not been investigated systematically. No explanation is available as to why male infants are at higher risk than female infants, and it is difficult to think of differences in lifestyle between male and female infants that would explain this variation in isolation rates. The rarity of person-to-person transmission despite the frequency of infection in infants and the low infectious dose raises the question of whether *C. jejuni* in human stools is infectious. The notable lack of outbreaks in midsummer remains to be explained. If nationwide events like the November 1984 peak in isolations occur again, targeted epidemiologic investigation, including serotyping and case-control studies, will be needed to determine their source.

Considerable effort toward controlling *Campylobacter* infections is also required. The rarity of sustained person-to-person transmission suggests that, in the context of sporadic cases of *C. jejuni* infections, there is little need for public health measures such as tracing contacts, screening food handlers, or closing day-care centers. The differences between the sources of outbreaks and of sporadic cases imply that different control measures are needed for the two situations. Universal pasteurization of milk and proper treatment of all drinking water might prevent 80% of the U.S. outbreaks due to *Campylobacter* but would have only a limited effect on the more frequent sporadic cases. Since contaminated raw poultry is the primary source of sporadic cases, measures that reduce the level of contamination or that improve chicken-handling practices in kitchens are likely to have the greatest impact on the incidence of the illness.

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Water-Related Disease Outbreaks, 1985

Michael E. St. Louis, M.D.
Enteric Disease Branch
Division of Bacterial Diseases
Center for Infectious Diseases

INTRODUCTION

Since 1971 CDC has tabulated data on waterborne disease outbreaks separately from those for foodborne disease outbreaks and compiled these data in annual reports. The Water-Related Diseases Activity has the following goals: 1) to determine trends in the incidence of water-related diseases in the United States, 2) to characterize the epidemiology of water-related diseases, 3) to disseminate information on prevention and control of water-related diseases to appropriate public health personnel, 4) to train federal, state, and local health department personnel in epidemiologic techniques used to investigate water-related disease outbreaks, and 5) to collaborate with local, state, and other federal and international agencies in initiatives concerning prevention of water-related diseases.

In addition to waterborne disease outbreaks associated with water intended for drinking, the Water-Related Disease Surveillance Report cites reports of 1) outbreaks of illness associated with exposure to recreational water and 2) epidemiologic investigation of gastroenteritis outbreaks on ocean-going passenger vessels that call at U.S. ports.

METHODS

Definition of Terms

A waterborne disease outbreak occurs when two or more persons experience a similar illness after consumption or use of water intended for drinking and epidemiologic evidence implicates the water as the source of illness. Also, a single case of chemical poisoning constitutes an outbreak if laboratory studies indicate that the water has been contaminated by the chemical. Only outbreaks associated with water intended for drinking are included.

Community public water systems (municipal systems) are defined as public or investor-owned water systems that serve large or small communities, subdivisions, or trailer parks with at least 15 service connections or 25 year-round residents. Noncommunity public water systems (semipublic water systems) are those of institutions, industries, camps, parks, hotels, or service stations that may be used by the general public. Individual systems (private water systems), which are generally wells and springs, are those used by one or several residences or by persons traveling outside populated areas. These definitions correspond to those in the Safe Drinking Water Act (Public Law 93-523) of 1974.

Disease outbreaks associated with water used for recreational purposes meet the same criteria used for waterborne outbreaks associated with drinking water. However, outbreaks associated with recreational water include illnesses due to exposure to or unintentional ingestion of fresh or marine water, but exclude wound infections caused by water-related organisms.

Sources of Data

State health departments report water-related disease outbreaks to CDC on a standard reporting form. In addition, the Health Effects Research Laboratory of the

Environmental Protection Agency (EPA) contacts all state water-supply agencies annually to obtain information about waterborne disease outbreaks. This present report includes information from both sources. Representatives from CDC and EPA review and summarize outbreak data and also work together to investigate and evaluate waterborne disease outbreaks. Also, on request by state health departments, CDC and EPA offer epidemiologic assistance, provide consultation in the engineering and environmental aspects of water treatment, and, when indicated, collect large-volume water samples to identify viruses, parasites, and bacterial pathogens.

As a part of their request for permission to enter a port, vessel masters of passenger cruise ships must report all persons who visited the ship's physician because of diarrheal illness during each voyage. In the event the ship's physician reports that 3% or more of passengers sought consultation for gastrointestinal illness on a 1-week voyage, a quarantine officer will board and inspect the ship, and an epidemiologic investigation may be conducted.

Interpretation of the Data

The data in this report have limitations, which one must recognize to avoid misinterpretation. The number of waterborne disease outbreaks reported to CDC and EPA clearly represents only a fraction of the total number that occur. Since investigations were sometimes incomplete or conducted long after the outbreak, the waterborne hypothesis could not be proved in all instances; however, it was the most logical explanation in these outbreaks. The likelihood of an outbreak's coming to the attention of health authorities varies considerably from one locale to another and depends largely upon consumer awareness, physician interest, and disease surveillance activities of state and local health and environmental agencies. Large interstate outbreaks and outbreaks of serious illness are most likely to come to the attention of health authorities. The quality of investigation conducted by state or local health departments varies considerably according to the department's interest in waterborne diseases and its budgetary, investigative, and laboratory resources. Additionally, the number of reported outbreaks due to different agents may depend on the interest of a particular health department or individual. For example, if epidemiologists or microbiologists become interested in *Giardia lamblia* or Norwalk-like viruses, they are likely to confirm more outbreaks caused by these agents. Furthermore, a few outbreaks involving many persons may vastly alter the relative proportion of cases attributed to various etiologic agents. Therefore, the reader should be aware that the numbers in this report do not represent either the true incidence of waterborne disease outbreaks or the relative incidence of waterborne diseases of various etiologies.

RESULTS

In 1985, 13 states reported 16 outbreaks of waterborne illness with 1,561 cases to CDC (Table 1). Bacterial agents were identified in four outbreaks. *Campylobacter jejuni* caused two outbreaks—one communitywide outbreak associated with the repair of a municipal water main and the other associated with consumption of untreated spring water at a recreational area near livestock pastures. An outbreak of *Shigella sonnei* infections was associated with drinking untreated well water at a summer camp. An outbreak of typhoid fever (*Salmonella typhi* infections) followed possible cross-contamination between parallel sewer and water lines during maintenance procedures. Three outbreaks were attributed to *G. lamblia*; all were associated

with drinking chlorinated but unfiltered water. In eight other reported outbreaks of acute gastrointestinal illness no agent was convincingly demonstrated. No waterborne outbreaks of documented viral diseases were reported in 1985.

In the one reported outbreak related to a chemical agent in the drinking water supply, 31 cases of dermatitis occurred. All patients had been exposed to levels of residual (free) chlorine as high as 27 mg/L in the municipal water supply (normal, < 1 mg/L). Symptoms included apparent contact dermatitis, urticarial rashes, skin burning or "flaking," and change in hair color to green for one person who also had chemical dermatitis. These symptoms were the result of excessive amounts of calcium hypochlorite, which had been added to the water to disinfect the lines immediately after repair.

In addition to disease outbreaks related to water intended for drinking, five outbreaks related to recreational water exposure were reported in 1985 (Table 2). Two outbreaks of giardiasis were associated with swimming in pools. Three outbreaks of *Pseudomonas* dermatitis were associated with the use of whirlpool baths or hot tubs.

In 1985, CDC personnel investigated four outbreaks of diarrheal illness on cruise ships calling at U.S. ports. In May, on a 1-week Caribbean cruise ending in Miami, at least 403 of 1,751 passengers developed gastroenteritis that was clinically compatible with a 27-nm Norwalk-like virus, but no disease agent was found by laboratory tests. Shrimp cocktail was implicated as the vehicle of illness. In July, on a 1-week Caribbean cruise out of St. Petersburg, at least 238 passengers suffered diarrhea and vomiting of generally short duration, but neither a disease agent nor a vehicle was

TABLE 1. Reported waterborne disease outbreaks, United States, 1985*

State	Month	Etiologic agent†	No. cases	Type of system§	Deficiency¶	Location of outbreak	Source
Ark.	Apr.	*Campylobacter*	19	NC	1	Resort	Spring
Ill.	July	AGI	18	NC	1	Recreation area	Well
Mass.	Nov.	*Giardia*	703	Com	1	Community	Reservoir
N.Y.	Feb.	*Giardia*	6	NC	3	Industrial plant	Cross-connection
N.Y.	Aug.	AGI	19	NC	2	Recreation area	Well
Okla.	Sept.	AGI	59	NC	1	Camp	Well
Pa.	Aug.	*Shigella*	27	NC	1	Camp	Well
P.R.	Aug.	AGI	274	Com	2	Community	Well
Va.	Apr.	*Giardia*	32	NC	1	Resort	Spring
V.I.	June	*Salmonella typhi*	60	Com	3	Community	Maintenance error
Vt.	Aug.	AGI	21	Com	2	Trailer park	Well
Vt.	Nov.	AGI	105	NC	1	School	Spring
Vt.	Nov.	AGI	19	NC	1	School	Spring
Wash.	July	AGI	18	Ind	1	Residence	Well
Wis.	Sept.	*Campylobacter*	150	Com	3	Community	Defective main
Wyo.	Apr.	Chlorine**	31	Com	3	Community	Broken main

*Please see methods section for description of reporting variables.
†AGI = acute gastrointestinal illness of unknown etiology.
§Com = community (municipal); NC = noncommunity (semipublic); Ind = individual.
¶1 = untreated ground water, 2 = treatment deficiencies, 3 = distribution system deficiencies.
**Illness was chemical dermatitis.

identified. In August and September, at least 387 of 945 passengers had a diarrheal illness on a cruise ship voyage along the Pacific coast of Mexico and California; however, because the cruise line failed to notify quarantine authorities in a timely manner, only a limited investigation could be conducted. In December, at least 70 of 540 passengers on a transatlantic cruise docking in Miami reported gastrointestinal illness associated with a seafood cocktail, but no agent was identified as the cause of illness.

DISCUSSION

The reported number of waterborne disease outbreaks and the number of associated cases in 1985 were the lowest since CDC began waterborne disease surveillance in 1971 (Table 3, Figures 1 and 2). Some evidence suggests that an actual decrease in water-related diseases is occurring. Active surveillance in some states reveals defects in water delivery systems, and as these are corrected, the potential for water-related disease outbreaks may be diminished. For example, Colorado received

TABLE 2. Reported disease outbreaks related to recreational water use, 1985

State	Month	Illness	No. cases	Etiologic agent	Location	Source
Ill.	July	Gastroenteritis	15	*Giardia*	Municipal area	Swimming pool
Minn.	Nov.	Dermatitis	4	*Pseudomonas*	Private party	Hot tub
N.J.	Sept.	Gastroenteritis	9	*Giardia*	Municipal area	Swimming pool
Vt.	Aug.	Folliculitis	14	*Pseudomonas*	Condominium	Whirlpool
Vt.	Dec.	Dermatitis	3	*Pseudomonas*	Motel	Whirlpool

TABLE 3. Reported waterborne disease outbreaks, by year and type of water supply systems, United States, 1971-1985*

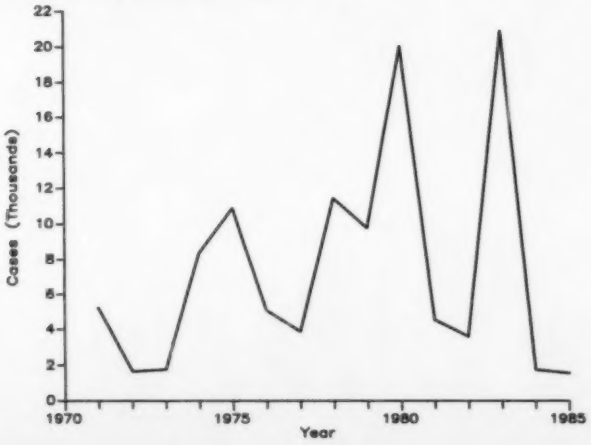
	Community	Noncommunity	Individual	Total	Total cases
1971	8	8	4	20	5,184
1972	9	19	2	30	1,650
1973	6	16	3	25	1,762
1974	11	9	5	25	8,356
1975	6	16	2	24	10,879
1976	9	23	3	35	5,068
1977	14	18	2	34	3,860
1978	10	19	3	32	11,435
1979	24	13	7	44	9,769
1980	26	20	7	53	20,045
1981	14	18	4	36	4,537
1982	26	15	3	44	3,588
1983	30	8	4	42	20,923
1984	12	5	8	25	1,742
1985	6	9	1	16	1,561
TOTAL (%)	211 (44)	216 (45)	58 (12)	485	110,359

*Please see methods section for description of reporting variables.

federal funds in 1980-1983 to improve surveillance of water-related disease outbreaks; for these years, the state reported an average of 4.5 outbreaks per year, in contrast to its previous average of only 2.0 outbreaks per year for the period 1971-1979 (*1*). For 1984 and 1985 together, however, only three outbreaks were discovered in that state, despite both active and passive surveillance of water-related

FIGURE 1. Reported outbreaks of waterborne disease, by year, United States, 1971-1985

FIGURE 2. Reported cases of illness associated with outbreaks of waterborne disease, by year, United States, 1971-1985



diseases. As other states begin to look for problems, they may also experience sudden increases in reported water-related diseases, followed by a decline in cases as identified problems are corrected.

The smaller number of outbreaks reported in 1985 may be due, however, to less complete reporting rather than to an actual decrease in outbreaks. The waterborne disease surveillance system is largely passive. Evidence suggests that this system contains only a small and variable fraction of the outbreaks and cases that occur yearly in the United States. Five states (Colorado, Oregon, Pennsylvania, Vermont, and Washington), with only 9.7% of the U.S. population, reported 42% of all waterborne outbreaks between 1971 and 1985 (Table 4). In 1982, three of these states, Colorado, Vermont, and Washington, received federal funds for surveillance through contracts with EPA (*2*), and Pennsylvania and Oregon have well-developed surveillance systems. Continued surveillance and, perhaps, special studies will be necessary to determine if the apparent decrease in reported outbreaks of water-related disease in recent years is a true trend.

TABLE 4. Reported outbreaks and cases of waterborne disease, by state, United States, 1971-1985

State	Outbreaks	Cases	State	Outbreaks	Cases
Alaska	10	950	N. Dak.	1	25
Ala.	6	183	Nebr.	1	23
Ark.	8	965	N.H.	7	943
Ariz.	8	2,416	N.J.	10	1,052
Calif.	26	6,271	N. Mex.	6	171
Colo.	52	9,868	Nev.	1	342
Conn.	6	1,269	N.Y.	17	7,040
Fla.	10	2,649	Ohio	9	1,003
Ga.	5	2,101	Okla.	6	625
Hawaii	2	72	Oreg.	21	3,875
Iowa	5	620	Pa.	93	28,760
Idaho	7	266	P.R.	4	3,474
Ill.	6	374	R.I.	1	20
Ind.	4	1,806	S.C.	5	342
Kans.	1	100	S. Dak.	2	17
Ky.	3	276	Tenn.	7	95
La.	1	26	Tex.	9	14,415
Mass.	6	1,248	Utah	8	1,549
Md.	7	431	Va.	8	110
Maine	7	343	V.I.	1	60
Mich.	4	82	Vt.	18	5,145
Minn.	10	418	Wash.	20	3,171
Mo.	5	865	Wis.	7	309
Miss.	2	207	W. Va.	4	1,109
Mont.	6	1,806	Wyo.	3	454
N.C.	9	618	**Total**	**485**	**110,359**

In 1985, *G. lamblia* was the most frequently identified pathogen for the seventh consecutive year, causing three (20%) of 15 waterborne outbreaks in addition to two outbreaks that resulted from unintentional ingestion of water in swimming pools. *Giardia* has been the cause of nearly all reported outbreaks of waterborne parasitic diseases in recent years, during which time this class of agents has increased as a proportional cause of all waterborne outbreaks (Table 5). In each of the outbreaks, as in well-characterized waterborne outbreaks of giardiasis in the past (*3,4*), water chlorination had been maintained at adequate levels to make outbreaks of bacterial diseases unlikely, but the lack of an intact filtering system capable of filtering *Giardia* cysts, distribution system problems, and mechanical deficiencies allowed drinking water to become a vehicle of giardiasis. Efforts are continuing to develop practical and efficient ways to detect *Giardia* cysts in water (*5-7*).

Campylobacter, the agent in two of four bacterial disease outbreaks, caused 10 (55%) of 18 waterborne bacterial disease outbreaks between 1980 and 1984. *Campylobacter* organisms have been detected in the flora of many domestic and wild animal species, and contamination of water sources by animals was suspected in many of the outbreaks. *Campylobacter* survives for months in surface water at 4°C (*7*) and in the past has been implicated in sporadic cases and outbreaks when the organism was isolated from both patients and animals (*8*).

The outbreak of waterborne typhoid fever is the first to be reported in the United States or its territories since 1974. Consistent with the fact that humans are the exclusive reservoir of *S. typhi*, contamination of the water system with human sewage rather than animal waste was suspected.

TABLE 5. Reported waterborne disease outbreaks, by type of agent, United States, 1971-1985

	Outbreaks					
Year	Bacterial	Parasitic	Viral	Chemical	AGI*	Total
1971	3	0	6	2	9	20
1972	5	4	5	3	13	30
1973	6	4	2	0	13	25
1974	5	4	0	5	11	25
1975	2	1	1	3	17	24
1976	3	3	0	3	26	35
1977	3	4	1	6	20	34
1978	7	4	3	2	16	32
1979	3	7	3	7	24	44
1980	3	8	6	7	29	53
1981	4	11	1	5	15	36
1982	3	12	7	3	19	44
1983	4	18	3	1	15	41
1984	4	7	2	3	9	25
1985	4	3	0	1	8	16
Total (%)	59 (12)	90 (19)	40 (8)	51 (11)	244 (50)	484

*AGI = Acute gastrointestinal illness

No waterborne outbreaks of viral diseases were reported in 1985. Identifying the agents of viral diseases is more difficult than identifying agents for parasitic or bacterial diseases. Hepatitis A has a much longer incubation period (15-50 days) than either bacterial or parasitic diseases, which complicates both outbreak identification and implication of the vehicle of transmission. Identification of outbreaks due to Norwalk virus, the Snow Mountain agent, and other 27-nm viruses depends on sophisticated laboratory techniques (*9,10*) and on the procurement of paired serum samples from patients for diagnosis. Reviews of common-source outbreaks of acute, nonbacterial gastroenteritis have suggested that many are due to Norwalk virus and related agents (*11*). The same may be true for some of the eight (50%) waterborne outbreaks of unknown etiology reported in 1985, particularly since Norwalk virus is more resistant to chlorine than many other viruses and may remain infectious at routine chlorination levels (5-6 mg/L free chlorine) (*12*).

In 1985, nine (60%) waterborne outbreaks were associated with noncommunity water systems. In the period 1971-1985, the number of outbreaks related to noncommunity systems was 45% of all reported outbreaks (Table 3). EPA estimates, however, that there are 20 million noncommunity, 180 million community, and 30 million individual water system users in the United States, so the rate of reported illness was far greater among noncommunity system users than among community system users. In 1985, six (37%) outbreaks were associated with water systems used on a seasonal basis. For the most part these are noncommunity systems, such as those in camps, parks, and resorts, which have a large demand placed upon them by visitors during specific periods of the year. In some instances, the systems cannot meet such demands. These water supply systems, especially those at campgrounds and parks, must be periodically reevaluated and monitored, and corrections must be made to ensure the continued provision of safe water during periods of increased demand. The large outbreaks that occurred during 1975 in Crater Lake and Yellowstone national parks (*13,14*) underscore the problems related to water supplies that can occur in recreational areas. Substantial differences exist in the types of deficiencies that lead to waterborne outbreaks associated with various water supply systems (Table 6).

The first outbreak of *Pseudomonas* folliculitis associated with the use of recreational water was reported in 1975 (*15*). Since then, the majority of outbreaks have been related to whirlpool baths, although outbreaks related to swimming pools have been reported (*16*). Outbreaks have not been reported at facilities in which pool water

TABLE 6. Deficiencies leading to waterborne disease outbreaks, by type of water system involved, United States, 1971-1985

	Type of deficiency*										
	Number (%)										
System	1		2		3		4		5		Total
Community	5	(2)	24	(11)	109	(52)	60	(29)	11	(5)	209
Noncommunity	13	(6)	96	(44)	79	(36)	17	(8)	12	(6)	217
Individual	15	(26)	33	(57)	0	(0)	4	(7)	6	(10)	58
Total	**33**	**(7)**	**153**	**(32)**	**188**	**(39)**	**81**	**(17)**	**29**	**(6)**	**484**

*1 = untreated surface water, 2 = untreated ground water, 3 = treatment deficiencies, 4 = distribution system deficiencies, 5 = miscellaneous

has been continually maintained at pH 7.2-7.8 with free residual chlorine levels of at least 1.0 mg/L (*17*). CDC recently published suggested health and safety guidelines for public spas and hot tubs (*18*). Also, EPA has published new guidelines for the microbiologic safety of fresh and marine water for swimming and other recreational uses (*19,20*).

Despite the underreporting of outbreaks and questions about the stability of the surveillance system for waterborne disease outbreaks, these data show the causes of reported waterborne disease outbreaks, the seasonality of outbreaks, and the deficiencies in water systems that most frequently result in recognized outbreaks. As in the past, the pathogens responsible for many outbreaks in 1985 were not determined. More complete epidemiologic investigations, advances in laboratory techniques, and standardized reporting of waterborne disease outbreaks should augment our knowledge of waterborne pathogens and the factors responsible for waterborne disease outbreaks.

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Salmonella Isolates from Humans in the United States, 1984-1986

Nancy T. Hargrett-Bean, Ph.D.
Andrew T. Pavia, M.D.
Robert V. Tauxe, M.D., M.P.H.
Enteric Diseases Branch and Statistical Services Activity
Division of Bacterial Disease
Center for Infectious Diseases

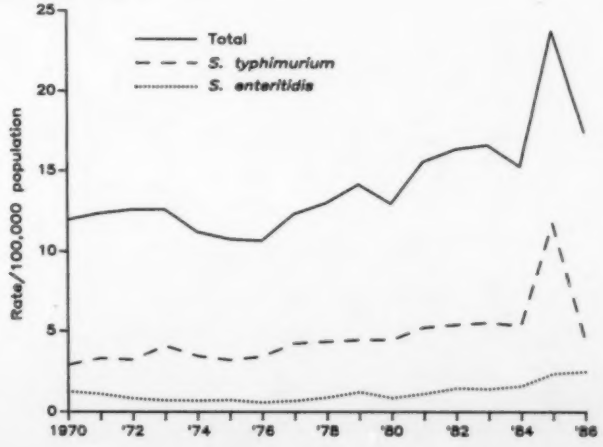
INTRODUCTION

Since 1962, *Salmonella* surveillance activity has been conducted jointly by the Association of State and Territorial Epidemiologists, the State Public Health Laboratory Directors, and CDC. This surveillance system is a passive laboratory-based system that receives weekly reports from 49 states and the District of Columbia and receives regular summaries from the Food and Drug Administration and the U.S. Department of Agriculture. The objectives of the surveillance system are 1) to define endemic patterns of salmonellosis, particularly those with interstate ramifications, 2) to identify trends in disease transmission, and 3) to monitor control efforts. The following report is based on data collected by this system in the years 1984-1986.

OVERVIEW

The *Salmonella* isolation rate reported to CDC continues to show a general upward trend (Figure 1). The number of *Salmonella* isolates from humans (including *Salmonella typhi*) reported to CDC was 36,061 in 1984, 56,750 in 1985, and 42,028 in 1986. Compared with the number reported in 1983 (38,886), these numbers represent a 7.8% decrease in reported isolates in 1984, a 48.5% increase in 1985, and an 8.1% increase in 1986.

FIGURE 1. *Salmonella* isolation rates, by total and selected serotypes and year, United States, 1970-1986



GEOGRAPHIC CHANGES

Table 1 shows the *Salmonella* isolates reported by region. The modest decrease in the number of reported isolates in 1984 was not confined to one state or region.States reporting decreases from 1983 included Arizona, 54% (518 to 239); Louisiana, 38%

TABLE 1. Frequently isolated *Salmonella* serotypes from human sources reported to CDC, by region, 1984-1986

Serotype/ Year	Region									
	New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Total
agona										
1984	49	101	164	53	155	38	87	32	263	942
1985	35	112	528	38	89	45	80	52	214	1,193
1986	57	103	223	40	96	52	73	41	227	912
berta										
1984	19	27	17	3	16	7	4	1	6	100
1985	23	36	36	6	8	6	5	0	6	126
1986	27	51	63	8	29	3	8	5	46	240
blockley										
1984	120	111	26	23	66	12	28	14	20	420
1985	84	96	35	7	54	9	12	4	20	321
1986	83	66	38	5	52	3	23	6	42	318
braenderup										
1984	32	135	63	15	45	32	48	2	42	414
1985	17	53	125	11	45	26	26	2	29	334
1986	43	83	303	19	49	53	22	1	43	616
derby										
1984	14	47	101	8	26	18	26	8	118	366
1985	16	38	85	13	31	9	15	9	69	285
1986	4	39	85	13	42	10	28	13	100	334
enteritidis										
1984	711	1,290	660	90	360	70	80	93	355	3,709
1985	994	2,192	876	189	695	149	147	67	302	5,611
1986	872	2,707	728	152	776	155	88	86	405	5,969
hadar										
1984	23	64	42	16	86	4	10	3	14	262
1985	100	260	289	36	348	78	24	4	58	1,197
1986	131	393	326	45	354	77	59	32	135	1,552
heidelberg										
1984	481	698	684	128	673	198	217	75	421	3,575
1985	615	1,069	1,048	274	820	280	352	90	648	5,196
1986	514	957	1,085	222	830	325	350	108	1,204	5,595
infantis										
1984	100	262	255	54	198	38	73	19	235	1,234
1985	112	177	254	37	179	66	90	28	163	1,106
1986	122	146	276	30	193	41	86	23	187	1,104
javiana										
1984	12	7	27	23	45	25	138	12	21	310
1985	18	29	31	12	35	30	157	12	21	345
1986	21	26	40	6	49	56	169	16	33	416
montevideo										
1984	96	71	94	38	71	23	80	12	152	637
1985	73	69	155	36	67	44	96	27	148	715
1986	36	71	260	25	81	47	58	31	167	776

TABLE 1. (*Continued*)

Serotype/ Year	Region: New England	Middle Atlantic	East North Central	West North Central	South Atlantic	East South Central	West South Central	Mountain	Pacific	Total
muenchen										
1984	49	41	86	43	68	38	67	24	109	525
1985	51	72	77	75	85	38	88	16	84	586
1986	44	53	96	183	113	23	55	34	93	694
newport										
1984	115	82	195	117	230	81	396	149	250	1,615
1985	78	70	165	86	345	77	437	199	995	2,452
1986	78	105	170	90	348	67	426	103	1,044	2,431
ohio										
1984	22	46	35	33	23	9	11	2	68	249
1985	23	42	50	41	22	11	14	9	52	264
1986	30	39	28	12	23	17	9	1	80	239
oranienburg										
1984	87	49	79	32	41	12	73	38	91	502
1985	49	50	132	55	45	19	56	26	69	501
1986	27	43	111	14	48	19	68	50	104	484
panama										
1984	14	9	60	12	33	8	30	13	44	223
1985	13	39	41	9	56	3	28	7	52	248
1986	20	18	30	8	45	2	28	17	67	235
saint paul										
1984	141	92	115	40	81	16	47	11	111	654
1985	57	87	95	11	56	20	33	7	76	442
1986	62	66	76	13	61	24	41	61	154	558
thompson										
1984	36	22	92	21	53	9	25	9	83	350
1985	29	47	162	47	73	14	19	4	49	444
1986	28	65	181	33	56	26	21	10	119	539
typhi										
1984	28	100	51	12	33	11	49	7	167	458
1985	27	89	48	7	29	5	46	6	213	470
1986	18	107	57	16	42	3	60	10	228	541
typhimurium										
1984	1,399	2,152	2,907	803	2,101	528	728	315	1,617	12,550
1985	1,334	2,164	19,079	671	2,066	673	794	276	977	28,034
1986	1,329	1,995	1,998	637	1,939	519	685	266	1,377	10,745
other										
1984	553	1,072	962	446	1,220	245	616	321	1,531	6,966
1985	686	697	1,109	332	1,327	299	666	386	1,378	6,880
1986	754	1,436	935	306	1,480	441	543	316	1,526	7,737
GRAND TOTALS										
1984	4,101	6,478	6,715	2,010	5,624	1,422	2,833	1,160	5,718	36,061
1985	4,434	7,488	24,420	1,993	6,475	1,901	3,185	1,231	5,623	56,750
1986	4,300	8,569	7,109	1,877	6,706	1,963	2,900	1,230	7,381	42,035
Total	**12,835**	**22,535**	**38,244**	**5,880**	**18,805**	**5,286**	**8,918**	**3,621**	**18,722**	**134,846**

(892 to 556); Alabama, 34% (734 to 484); Texas, 20% (2,125 to 1,708); and New York, 17% (2,916 to 2,409).

The marked increase in the number of *Salmonella* isolates reported from 1984 to 1985 was due largely to a massive *Salmonella typhimurium* outbreak, which accounted for over 16,000 cases in the East North Central Region (*1*). States reporting large increases included Illinois, 614% (2,699 to 19,292); Indiana, 173% (443 to 1,210); Alabama, 53% (484 to 740); Michigan, 44% (1,403 to 2,026); Montana, 44% (64 to 92); South Dakota, 42% (62 to 88); and Louisiana, 42% (556 to 788).

Although the overall number of isolates reported in 1986 was lower than in 1985, many states reported more isolates in 1986 than in 1985, including Delaware, 138% (26 to 62); Alaska, 50% (119 to 178); Rhode Island, 46% (181 to 264); Washington, 43% (550 to 786); Wisconsin, 45% (630 to 915); Pennsylvania, 34% (2,253 to 3,021); and California, 32% (4,366 to 5,764).

CHANGES AMONG COMMON SEROTYPES

In 1984, the 10 most frequently reported serotypes constituted 72% of all reported isolates (Table 2). During this year, reports of all serotypes decreased, except for *Salmonella muenchen*, which increased 5%, and *Salmonella enteritidis*, which increased 14%. Reported outbreaks of *S. enteritidis* occurred in a private home, a hospital, an industrial plant, a nursing home, a school cafeteria, a prison, a restaurant, and a wedding reception. Additional *S. enteritidis* outbreaks were associated with consumption of sausage in Washington, of rice pilaf in Pennsylvania, and of eggs in New Jersey.

In 1985, the 10 most frequently reported serotypes accounted for 82% of all reports. The number of *S. typhimurium* isolates increased 121% over the number reported in 1984; more than 16,000 cases were due to a milk-borne outbreak in Illinois

TABLE 2. *Salmonella* serotypes most frequently isolated from humans, United States, 1984-1986

	No.of Isolates (%)						Rank		
Serotype	**1984**	**(%)**	**1985**	**(%)**	**1986**	**(%)**	**1984**	**1985**	**1986**
*S. typhimurium**	12,724	(35)	28,154	(50)	10,888	(26)	1	1	1
S. enteritidis	3,709	(10)	5,611	(10)	5,967	(14)	2	2	2
S. heidelberg	3,575	(10)	5,196	(9)	5,595	(13)	3	3	3
S. newport	1,615	(4)	2,452	(4)	2,431	(6)	4	4	4
S. infantis	1,234	(3)	1,106	(2)	1,104	(3)	5	7	6
S. agona	942	(3)	1,193	(2)	912	(2)	6	6	7
S. saint paul	654	(2)	442	(1)	558	(1)	7	13	11
S. montevideo	637	(2)	715	(1)	775	(2)	8	8	8
S. muenchen	525	(1)	586	(1)	694	(2)	9	9	9
S. oranienburg	502	(1)	501	(1)	484	(1)	10	10	14
S. braenderup	414	(1)	334	(1)	616	(1)	13	15	10
S. hadar	262	(1)	1,197	(2)	1,552	(4)	18	5	5
Subtotal	26,793	(74)	47,487	(84)	31,576	(75)			
Other	9,268	(26)	9,263	(16)	10,452	(25)			
Total	**36,061**	**(100)**	**56,750**	**(100)**	**42,028**	**(100)**			

*Includes *S. typhimurium* var. *copenhagen*.

and surrounding states. Reported *Salmonella hadar* isolates increased 357%. Outbreaks of this serotype were reported from Wisconsin, Washington, and New York; no vehicles of transmission were implicated. Reported *Salmonella heidelberg* isolates increased 45%; outbreaks were associated with consumption of eggs in New Mexico and of barbecue in California. Outbreaks of *Salmonella newport*, which increased 52%, were associated with consumption of raw hamburger in California and of raw milk in Washington.

In 1986, the 10 most frequently reported serotypes accounted for 82% of all reported isolates. During that year, reported *S. typhimurium* isolates dropped to the lowest level since 1980. This decrease was more than offset by increases in reported isolates of *S. enteritidis*, *S. heidelberg*, and *S. hadar*. In the period 1976-1986, the New England and the Middle Atlantic regions experienced a fivefold increase in the number of reported *S. enteritidis* isolates (*2*). Several reported outbreaks from these areas were associated with eggs and foods containing raw eggs. Reports of *S. hadar* isolates increased 30% over the number reported in 1985; Georgia reported an outbreak of this serotype. Reported isolates of *S. heidelberg* increased 8%, and outbreaks were associated with lupine beans in Massachusetts, roast pork in Delaware, frozen pasta in the Northeast, and chicken in Oklahoma, Wisconsin, and Hawaii. Increases in the number of reports of *Salmonella saint paul* (26% increase) were not confined to any single region.

LESS FREQUENTLY REPORTED SEROTYPES

The reported number of *Salmonella kottbus* isolates increased from four in 1983 to 40 in 1984. California reported 24 of these isolates. The reported number of *Salmonella berta* isolates increased 127% from 44 to 100; Pennsylvania reported 16% of these isolates. Reports of *Salmonella bonariensis* increased from two to seven isolates, and reports of *Salmonella carrau*, from two to 12 isolates; these increases were not confined to any single state. The number of *Salmonella braenderup* isolates increased from 324 to 414; an outbreak of this serotype was associated with consumption of beef in New Jersey. The number of *Salmonella bredeney* isolates rose from 140 to 178. New York City reported an outbreak of this serotype that was associated with eating roast beef in a deli. Reported isolates of *Salmonella ibadan* increased from seven to 15; all reports were from Alabama, Arkansas, and Texas. *Salmonella ohio* isolates increased from 196 to 249; increases of this serotype were reported from Massachusetts, Hawaii, and California. The reported number of *Salmonella brandenburg* isolates increased from 58 to 88. Louisiana and New York together reported 20.5% of these isolates. Reported isolates of *Salmonella adelaide* increased from 45 to 78; Illinois, New York, and Virginia accounted for 51% of these isolates.

During 1985, the reported number of *Salmonella poona* isolates increased 154% (88 to 224). An outbreak of this serotype occurred in a school in Illinois. The number of *S. kottbus* isolates increased 208% (40 to 123). Outbreaks of this serotype were reported in Oregon and California. Increases were reported in *Salmonella bere* (two to 22), *S. brandenburg* (88 to 171), and *Salmonella bovismorbificans* (24 to 53); these increases were not confined to one state or region.

In 1986, reported isolates of *S. braenderup* increased 84% (334 to 616); an outbreak of disease in Illinois caused by this serotype was associated with eating tomatoes. Alabama reported 82% of the *Salmonella bardo* isolates, which increased from seven to 28 isolates. No single area was associated with the increased isolation of

Salmonella alachua (150% increase, from 48 to 120), *S. berta* (90% increase, 126 to 240), and *Salmonella johannesburg* (170% increase, 17 to 46).

S. TYPHI

In 1984, 458 isolates of *S. typhi* were reported; 121 were reported to have come from patients with typhoid fever, and 24, from carriers. In 1985, 470 isolates were reported, 71 from patients and 17 from carriers. In 1986, 541 were reported, 115 from patients and 14 from carriers. Patient or carrier status of the remainder of the *S. typhi* isolates for each of these years was not designated. The median age of patients was 22 years in 1984 and 24 years in 1985 and 1986, and the median age of carriers was 71, 58, and 69 years, respectively.

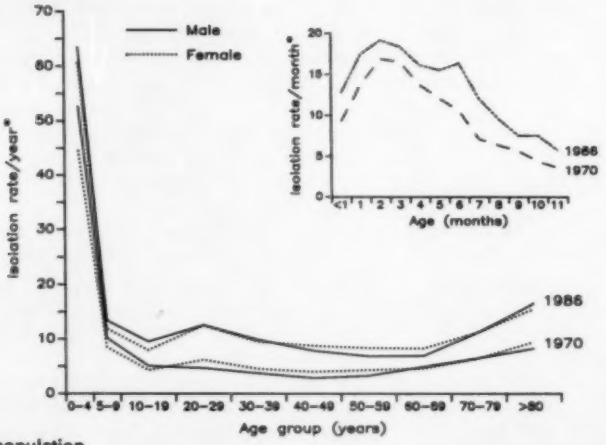
AGE

Figure 2 shows age-specific isolation rates for the years 1970 and 1986. Patient age was reported for 79% of the isolates in the period 1984-1986. The rates of reported *Salmonella* isolates were highest for 1- to 4-month-old infants, decreased abruptly among early childhood age groups, remained relatively constant through the adult years, and then increased slightly in the age group over 80 years of age. The rates were slightly higher among males under 20 years of age and were slightly higher for females 40-69 years old. The median age of persons from whom isolates were obtained has increased from 6 years in 1970 to 18 years in 1984, 13 years in 1985, and 20 years in 1986. The largest increase in an age-specific isolation rate occurred among the 20- to 39-year-old age groups.

COMMENT

This summary is based on the passive laboratory-based *Salmonella* surveillance activity, and the reports received in this system do not distinguish between symptomatic and asymptomatic infection or chronic carriage, except in the case of *S. typhi*. Cases of salmonellosis without laboratory confirmation are not included. The system

FIGURE 2. *Salmonella* isolation rates, by age and sex of patient and year, United States, 1970 and 1986



*Per 100,000 population.

has inherent biases that must be remembered. Many factors, including intensity of surveillance, severity of illness, access to medical care, and association with a recognized outbreak, affect whether an infection will be reported. Infants, the elderly, and severely ill patients are more likely to have stool cultures performed. Reporting of *Salmonella* isolates is incomplete, and the true incidence of salmonellosis is substantially underestimated. However, these data permit broad comparisons, provide information that may lead to epidemiologic investigations, identify trends, and allow some insight as to the effectiveness of public health interventions.

In general, the overall rate of *Salmonella* isolation has increased since 1976, with brief decreases in the years 1980 and 1984. During this period no major changes have been recognized in the *Salmonella* surveillance system, and the increase is limited to certain serotypes. *Shigella* isolates, reported through a parallel surveillance system, did not show a similar increase during this same period (*3*). Thus, the increase in the incidence of reported isolations is likely to represent a real increase in the incidence of *Salmonella* infections in the United States rather than improved reporting. The median age of persons from whom isolates were reported has continued to increase faster than the median age of the general population, and the rate of isolation has increased most among 20- to 39-year-olds. The reasons for this shift in age are unknown but may indicate that foods to which older children and adults are commonly exposed are becoming more important vehicles of transmission.

The increase in specific serotypes is only partially understood. In California a large and ongoing outbreak of *S. newport* infections was traced to a reservoir in dairy cattle used to make ground beef, and the spread of this epidemic strain to cattle in other states has been documented (*4,5*). The marked increase in *S. enteritidis* in the northeastern United States appears to be related to eating raw or undercooked eggs (*6*). *S. heidelberg* and *S. hadar* have been associated with consumption of poultry in the past, but it is not known if the current increases in these serotypes are related to poultry.

The serotyping of *Salmonella* isolates is critical in recognizing outbreaks and new vehicles of infection. Recently, the application of molecular biologic techniques, such as plasmid profile analysis, to epidemiologic studies has provided additional means to investigate outbreaks caused by common serotypes that may otherwise go unrecognized. Better understanding of the reservoirs and routes of transmission of the major serotypes may lead to specific control measures.

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CDC gratefully acknowledges the assistance provided by State and Territorial Health Statistics Directors and their staffs.

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Source: Association for Vital Records and Health Statistics

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State and Territorial Epidemiologists and State Laboratory Directors are gratefully acknowledged for their contributions to this report. The persons listed below were in the positions shown as of May 1988.

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Atlanta, GA 30333

HHS Publication No. (CDC) 88-8017